SYRTIS MAJOR-ISIDIS PLANITIA TRANSITION, MARS: PRELIMINARY EVALUATION OF A POTENTIAL MARS SURVEYOR PROGRAM LANDING SITE

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INTRODUCTION. An important goal of potential Mars Surveyor program is the evaluation of volatile sources and sinks, climate history, and environments of pre-biotic processes. Sites situated in low latitudes, low altitudes, and in areas where there is geologic evidence for past volatiles [1] are therefore primary candidates for future Mars Surveyor investigations. In this study the surface of the Syrtis Major Planum-Isidis Planitia transition is examined through high-resolution geologic mapping and (models of subsurface water transport and processes whereby volatiles may be locally concentrated and serve as potential sites of pre-biotic processes. A variety of evidence may be cited that indicate both the presence of water and ice within the basin interior and along the basin margin. These, in combination with the relatively low-latitude setting and potential long-term availability of sub-surface water, imply a potential history of volatile emplacement and movement within the crust and near surface along the transition. A well-chosen site in this area also offers the possibility of addressing questions regarding the chemical and petrologic characteristics of two fundamental types of martian crustal materials.

BACKGROUND. Sites of pre-biotic processes and habitats for early life require relatively long-term supplies of water as well as the minerals necessary for metabolic processes [2]. There are many sites for which there is past evidence for water at the surface, although transient. Alternatively, subsurface water may have existed in some areas for extended periods. Given the potential for viable organism in the subsurface, the water need not be present as open bodies of water and subsurface environments may be equally important.

The surface evidence for the long-term presence of water and volatiles are more subtle in comparison with evidence of channeling and valley formation. The distinguishing characteristics and possible distribution of such sites need to be better evaluated. Areas of catastrophic outflow, while bearing the most dramatic evidence for past flow of water, are unlikely to have been sites of long-term water availability suitable for either pre-biotic processes or stable habitats. Valley networks, together with along-valley areas of ponding, offer greater potential for stable bodies of water [3], but the flow of water at the surface may have been relatively transient in many cases [4], and may not even be necessary for the formation of many valleys [5]. Seepage of ground water at the surface (springs) may have been more stable and long-lived. Such sites may be characterized by anomalous surface alteration or even morphologic evidence for thermal and non-thermal spring deposits. An additional consideration is access for landed science: valleys present severe challenges for targeting landers and for mobility of rovers once landed. More accessible, yet similar sites of long-term water seepage may have existed along certain areas of highland-lowland transition, particularly where there is either evidence for fretting or scarp retreat.

SYRTIS-ISIDIS TRANSITION. The characteristics of the surface along the transition zone from Syrtis Major to Isidis Planitia (10°N , 280°W, Fig.1) are favorable to the development of long-term water seepage, mineral deposition and surface alteration, and corresponding pre-biotic processes. This area is dominated by the abrupt topographic transition (2 to 5 km altitude over 200 km laterally) from the high plateau surface of Syrtis Major to the basin of Isidis Planitia. The surface of Syrtis Major consists of a low and broad shield volcano-like accumulation of lava flows [6] radiating from at least two calderas, Nili Patera and Meroe Patera. At the point where the eastern slope of Syrtis Major Planum meets the margins of the low-lying and relatively flat Isidis Planitia, identifiable lava flows terminate or become overlain by basin fill, and the surface characteristic undergoes a transition to hummocky plains within the Isidis basin. The plains differ from those in many basins and their characteristics have been interpreted to reflect sedimentary fill composed predominantly of ice and dust accumulated during epochs of substantial water flux on Mars [7]. Much of the original ice content was interpreted to result from air fall [7]. Because Isidis basin is encircled by highlands over much of its perimeter, it represents a natural catchment for runoff and subsurface infiltration

The characteristics of the crust of Mars are such that relatively permeable aquifers are likely to be present and may be important in both the long-term storage and transport of water [8]. The steep topographic gradients and thick volcanic cap rock of Syrtis Major provide a strong gradient overlain by an aquiclude to enhance subsurface flow of water entering the basin from the west. Consistent with this scenario, spectral data from the ISM experiment of the Phobos mission [9] suggest that the surface of rocks in eastern Syrtis Major have been permanently altered. In contrast to the variable albedo and color at many places on Mars, surface spectral characteristics in eastern Syrtis are relatively stable, and characterized by greater ferric iron content [9], as might occur through exposure to oxidizing agents and water. In addition, steep scarps and fretted surfaces along the transition zone at the base of the regional eastern Syrtis Major slope are consistent with the interaction of near-surface and emergent water along the western Isidis margin.

The Syrtis Major-Isidis Planitia transition is of further scientific interest because it is a site of relatively young lavas of primitive characteristics, and therefore may represent simple mantle melts useful as indicators of bulk mantle composition and first order magmatic processes in general. In contact with these lavas, in many places, there are substantial massifs of highland type material that offer opportunities to examine highland compositions and petrologic characteristics.

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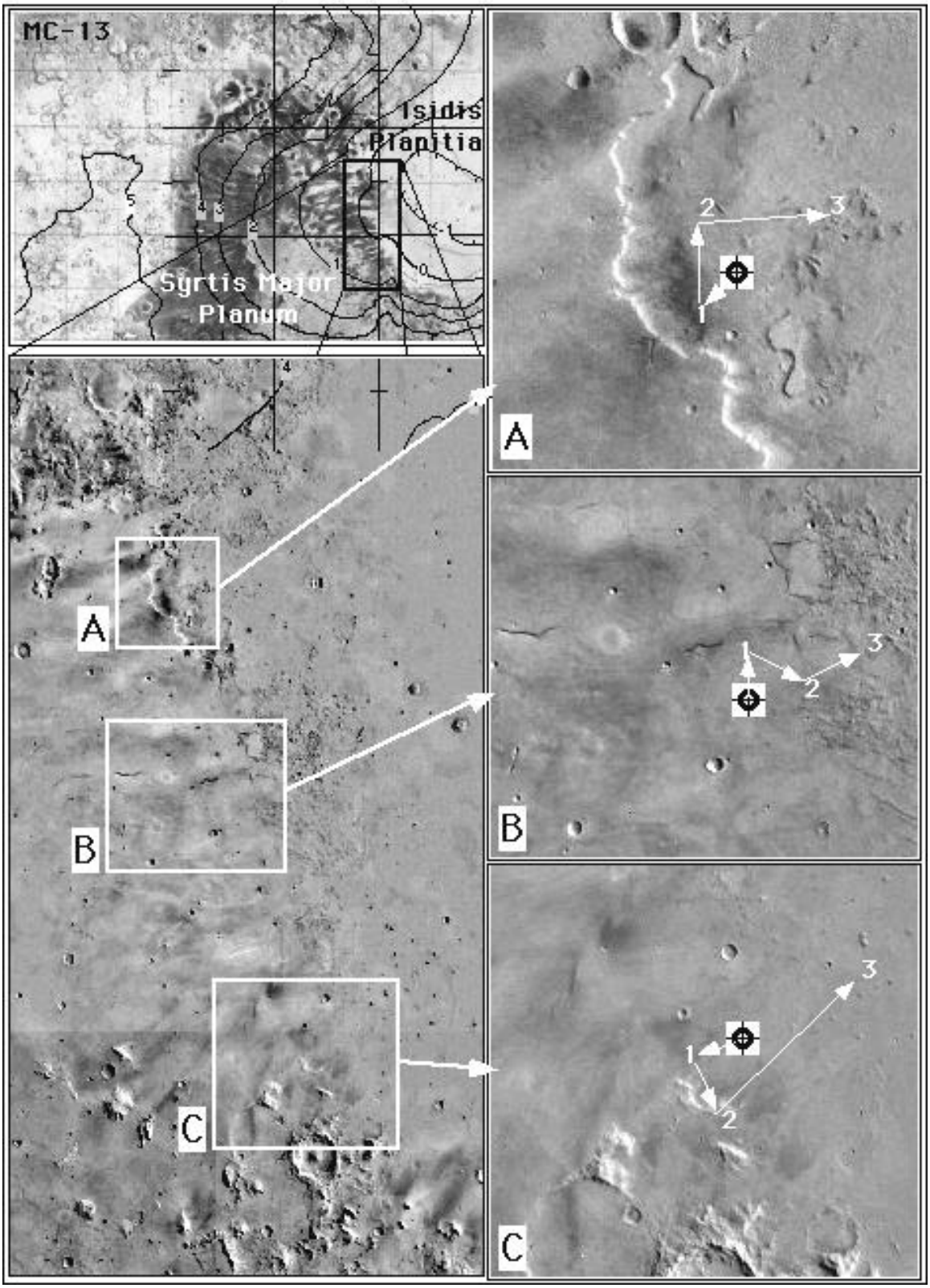

Figure 1. Mars Surveyor Program landing site proposed is in the transition between Syrtis Major Planum and Isidis Planitia. Three areas of focused mapping are indicated by boxes **A** and **B** (potential spring discharge), and **C** (surface alteration, and both young lavas and old highlands rocks) and in inserts at right. Possible sites of interest and traverse sequence shown indicated with arrows. Shaded relief base is from U. S. Geological Survey (1991) map I-2179.